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REQUEST FOR PROPOSAL (RFP)

FOR

Tennessee Valley Authority

Waste Heat Recovery (WHR)

November 1, 2013

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1. Background

The Tennessee Valley Authority (TVA), a corporation created and existing by virtue of the Tennessee Valley Authority Act of 1933, as amended (TVA Act) and owned by the U.S. government, provides electricity for nine million people in parts of seven (7) southeastern states. TVA has renewed its vision to lead both the Tennessee Valley region and the nation toward a cleaner and more secure energy future with increased reliance upon cleaner energy sources and energy efficiency.

In April 2011, TVA entered into clean air agreements with the Environmental Protection Agency (EPA), four states and three environmental groups ("EPA Agreements"). These Agreements provide for the implementation of environmental mitigation projects that support cleaner air across the region. TVA chose projects to align with its vision for a cleaner energy future. This Waste Heat Recovery (WHR) installation project is one of the environmental mitigation projects to be implemented under the EPA Agreements.

2. Purpose

This project seeks to develop at least 5 MW of waste heat recovery-based electricity generation through the leveraging of funds to the greatest extent possible with one or more industrial customers providing an optimum waste heat profile (applicable quantity and grade of waste heat). This initiative may result in more than one project award depending on the level of matching funds from industrial customer proposals through the RFP process. Proposers will be responsible for the development, design, engineering, construction, operation and maintenance of a system in which clean energy is generated from recovering waste heat from their facility and converted to electricity. Collaboration and engagement with major industrial customers, other organizations and the TVA will be key to the success of this initiative. This approach will be the catalyst for supporting innovative, efficient clean energy deployment in the Valley. TVA expects the life of the project to be twelve years during which parameters such as megawatt hours, energy savings, and emission reductions will be documented.

Specific objectives include:

- Increasing TVA's industrial customers' access to clean energy from WHR.
- Providing highly leveraged funding opportunities for new clean energy in the Valley.
- Providing a model for future innovative and cost-effective clean energy technologies.

3. Waste Heat to Power

Waste heat recovery generally refers to the process whereby waste heat already being emitted by an industrial facility is captured and converting this heat stream into clean electricity. It is a form of distributed energy produced and used at the end-user's facility. Waste heat to power is an important

resource for providing clean energy without additional emissions, improving industrial energy efficiency, and providing benefits to the electric grid. Benefits of WHR include:

- For electric utilities
    - Reduced energy losses in transmission lines
    - Reduced upstream congestion on transmission lines
    - Deferred Transmission & Distribution infrastructure investments
    - Improved grid reliability
    - Ancillary benefits including voltage support & stability, contingency reserves and black start capability
- For industry
    - Improved energy efficiency
    - Improved power quality & reliability
    - Improved energy cost predictability
    - Business continuity
- For society
    - Cleaner air
    - Energy security
    - Economic development

WHR Technologies

Generating power from waste heat involves using the waste heat to create mechanical energy that drives an electric generator. The efficiency of waste heat converted to power generation is heavily dependent on the temperature of the waste heat source. In general, power generation from waste heat has been limited to only medium to high temperature waste heat sources. However, advances in alternate power cycles may increase the feasibility of generation at low temperatures. The following are the basic WHR technologies.

Steam Rankine Cycle

The most frequently used system for power generation from waste heat involves using the heat to generate steam, which then drives a steam turbine. The traditional steam Rankine cycle is the most efficient option for waste heat recovery from exhaust streams with temperatures above about 700˚F [370˚C].

Organic Rankine Cycle

The Organic Rankine Cycle (ORC) operates similar to the steam Rankine cycle, but uses an organic working fluid instead of steam. Options include silicon oil, propane, haloalkanes (e.g., "freons"), isopentane, isobutane, pxylene, and toluene, which have a lower boiling point and higher vapor pressure than water. This allows the Rankine cycle to operate with significantly lower waste heat temperatures— sometimes as low as 150˚F [66˚C].

Kalina Cycle

The Kalina cycle is a variation of the Rankine cycle, using a mixture of ammonia and water as the working fluid. A key difference between single fluid cycles and cycles that use binary fluids is the temperature profile during boiling and condensation. For single-fluid cycles (e.g., steam or organic Rankine), the temperature remains constant during boiling. As heat is transferred to the working medium (e.g., water), the water temperature slowly increases to boiling temperature, at which point the temperature remains constant until all the water has evaporated. In contrast, a binary mixture of water and ammonia (each of which has a different boiling point) will increase its temperature during evaporation.

Some of the market sectors with potential for waste heat recovery include:

- Pulp and paper mills
- Steel and metal manufacturing and refineries
- Glass manufacturing and melting
- Incinerators
- Brick manufacturing
- Petroleum products manufacturing
- Cement plants
- Chemical plants
- Ethanol plants
- Gas pipeline compressor stations
- Oil and gas extraction Artificial synthetic fibers, rubber, and resin manufacturing

At a particular industrial site, some of the potential sources of waste heat include:

- Process heaters
- Furnaces, ovens, or kilns
- Boilers
- Conductive, convective, and radiative losses from hot equipment surfaces
- Conductive, convective, and radiative losses from heated product streams
- Hot combustion gases otherwise discharged to the atmosphere
- Natural gas pipeline compressor
- Other natural gas-fired turbines or oil-fired turbines
- Reciprocating engine exhaust
- Cooling water from furnaces , air compressors, and internal combustion engines

4. Scope of Project

This project will provide funds (up to $7 million total program) to large industrial customers that operate facilities within the TVA service area to help offset the cost of the development, design, engineering, construction and operation of waste heat recovery projects of a total at least 5 MW . Existing commercial WHR technologies may be used to recover the waste heat and convert it to electricity. Projects within the WHR market are expected to have a useful operating life (EUL) of at least twelve years, and submissions should utilize estimated useful life (EUL) as a criterion in the estimation of energy generated and maintenance sections. TVA will leverage its funds to foster the proposer's financial participation in this project such that an optimum waste profile is achieved in terms of the quantity and grade of waste heat recovered by the project. This initiative may result in multiple project approvals depending on the level of matching funds from industrial customer proposals and the size in generation of project submittals, which will be competed through this Request for Proposal (RFP) process.

TVA will provide general technical oversight and financial assistance with the project's capital funding by issuing progress-based payments during the design, construction and commissioning period. TVA will also conduct appropriate measurement and verification activities to determine energy efficiency benefits of the WHR installation.

All organizations intending or considering submitting bids to this RFP are asked to remit by November 15 an "Intent to Bid" form (See Appendix II) to the designated RFP Contact Person, Veronica Wilson at vwilson@tva.gov. Only those submitting this form will receive updates to the RFP.

The scope of this project shall include the following activities to be conducted by the proposers:

4.1 Preliminary Assessment

The purpose of the preliminary assessment is to provide enough information on project economics to make decisions regarding investment in WHR, while minimizing the amount of upfront time and money spent. The primary tasks are to identify a preliminary WHR system size, to calculate simple payback, and to determine the general cost range of system installation and maintenance.

4.2 Selection of WHR technology

Based on the results of the preliminary assessment, the proposer will select the WHR technology, power block technology, primary equipment and configuration, and will contact vendors to assess price, performance, schedules, and guarantees.

4.3 Permitting

The proposer will obtain all environmental permits, site permits/licenses and other required approvals for the project.

4.4 Environmental Review and Acceptability

A. All interested parties are urged to consult TVA‟s National Environmental Policy Act (NEPA) Compliance procedures prior to submitting an Application to determine the likelihood that, and the timeline in which, their project can be reviewed for environmental acceptability. This process typically involves preliminary determinations by TVA of:
   a) whether or not provisions of the NEPA and related laws apply to the decision; and,
   b) if so, which of three levels of review would be initiated. TVA‟s implementing procedures for NEPA are available at www.tva.com/environment/reports/pdf/tvanepa_procedures.pdf.

B. Applicants are responsible for all costs associated with the conduct of, and preparation of documentation for, the appropriate level of environmental review. If the provisions of NEPA apply, applicants may:
   a. use TVA as the preparer;
   b. use a TVA pre-qualified contractor; or,
   c. propose a contractor for the project by submitting the contractor's qualifications for evaluation and determination of acceptability by TVA.

Neither the Application nor TVA's Waste Heat Recovery project covers any aspect of the NEPA review. These reviews must be arranged separately.

4.5 Detailed Front End Engineering Design (FEED)

FEED will include size and location of the WHR equipment, design drawings that include process flow diagrams, equipment specifications, monitoring and control specification, piping and wiring, and tie-in to existing systems. Project schedule will also be developed.

4.6 Economic Evaluation

The proposer will develop a project economic evaluation that should include at a minimum cash flows, capital requirements, net present value, payback schedule, depreciation, and rate of return. Projects that have a payback of less than three years are not eligible for funding.

4.7 Consumption of Generated Output

Responses that include total consumption of all energy produced by the waste heat recovery system will be evaluated as having an advantage over responses that have excess generation not consumed on-site, but responses will not be disqualified if excess electricity is produced. Requirements for exporting excess electricity can be found in Appendix I at the end of this document.

4.8 Subcontractor Selection

Proposer will determine which project tasks will be subcontracted. Review the capabilities of individual subcontractors; consider previous project experience and track records.

4.9 Equipment Specification and Procurement

The proposer will prepare WHR equipment specifications for procurement. Specifications will define the performance requirements of the equipment, materials of construction, fabrication methods and procedures, and test and inspection requirements. Proper definition of these items will ensure that the equipment supplied will meet the performance requirements of the plant.

4.10 Construction

The proposer will be responsible for all construction activities necessary to properly and safely build and install the WHR system, the associated power generation system, and balance of plant.

4.11 System Prove Out and Commissioning

The proposer will be responsible for conducting subsystem shakedown and the WHR system test runs to verify proper system design and installation for safe commercial operation. Upon completion of any electric system upgrades required to interconnect the WHR system to the electric system, and after the WHR system has been verified as operational per design specifications and proven to be safe, then the proposer will commission the system on the commercial operation date.

4.12 Operations and Maintenance (O&M)

The proposer will be responsible for the safe operation and maintenance of the WHR system so that it provides expected energy savings and reduces emissions as detailed in the proposal by running reliably and efficiently. Proposals must include a detailed maintenance plan as a part of their submittal, as well as examples of how they have successfully maintained other processes within their organizational facilities.

5. Proposal Content

- **Cover Letter**
    - Proposer Name
    - Organization
    - Mailing address
    - WHR Facility address
    - Email address
    - Phone number
    - Project rated output, MW
    - Estimated net annual electric generation, MWh
    - Total cost of project
    - Total funds provided by proposer
    - List of all team members

- Experience of team members with WHR system installation and maintenance
- Project name
- Brief project executive summary

- **Project Narrative**

  The proposer will write a clear and concise description of the overall project approach, including specific activities that will take place. Particular attention should be paid to description of plans, strategies, methods and activities that enable the team to be successful in meeting the WHR project goals.

- **Team Qualifications and Experience**

  The proposal shall demonstrate the strength of the collaborative partnership by providing a brief biography for each key person and/or subcontractor on the project team, detailing experience on relevant projects.

- **Technical Information**
  - Proposer shall supply documents, drawings, calculations, etc, sufficient to provide:
  - System description
  - WHR core technology
  - Power block technology
  - Capacity rating, MW Estimated net annual electric generation, MW Facility nominal load, MW
  - Facility operating schedule
  - Estimated annual operational availability of WHR system, %
  - Waste heat temperature and flow rate
  - Site/location
  - Site arrangement/equipment layout
  - Estimated annual generation
  - Project WHR system life, Years
  - Equipment details & description
  - Vessels (feedwater, steam drum, etc)
  - Heat exchangers (economizers, evaporators, etc)
  - Pumps
  - Valves
  - Ducts
  - Insulation
  - Turbine
  - Generator
  - Environmental controls (baghouse, etc)
  - Expanders
  - Instrumentation, controls, electrical
  - Electrical equipment schedule and layout, including interconnection

6. Budget Information

The proposal will include the estimated cost to perform the work. The template below is suggested, but alternative methods of representing the project budget are acceptable. The proposer shall also disclose the both amount and sources of additional funds that is intended to use towards the project. These additional funds may be funds made available by the proposing

entity itself, but could also include money allocated under other EPA Agreements to the states or under government incentive programs.

	SITE DEVELOPMENT	Cost
	Design	
	Permits	
	PROJECT DEVELOPMENT	
	Consulting	
	Proposal development	
	Project Management	
	WHR SYSTEM	
	Vessels	
	Heat Exchangers	
	Pumps	
	Construction	
	Balance of Plant	
	POWER BLOCK	
	Turbine	
	Generator	
	CONSTRUCTION	
	ANNUAL OPERATING EXPENSES	

	OTHER FUNDING SOURCES	Amt
	Estimated revenue DPP	
	Federal, state or local funding	

7. Maintenance Plan

The proposal shall include a proposed maintenance plan for the successful operation of the WHR facility and equipment that details how the organization will meet and/or exceed the Estimated Useful Life of the equipment of twelve years.

8. Legal Authority

Please identify the proposing entity's (1) legal authority for accepting the funds TVA would provide for this project, and (2) legal authority to conduct the project.

9. Letters of Support (optional)

Please include a signed letter of support from a representative of each member organization comprising the proposal team.

10. Schedule

Milestone	Date
RFP to industrial customers	November 1, 2013
Open Window for submitting questions	November 1-15, 2013
Questions on RFP and Intent to Bid form due	November 15, 2013
Responses to questions posted to Online Connections	November 20, 2013
Conduct WHR Webinar Workshop	December 4, 2013
RFP Responses Due	March 1, 2014
Evaluate proposals and award contract(s) for WHR projects	May 2014
Environmental permitting and reviews	Summer 2014
Detailed design and engineering package	Fall 2014
Design review and approval	Winter 2014
Equipment procurement	Spring 2015
Begin site preparation	Spring 2015
Begin construction, development of operating procedures	Summer 2015
Construction complete	Late 2015
System prove-out, operations training	Spring 2016

11. Evaluation Criteria

Ratings will be based on TVA's sole judgment. TVA may contact proposers for clarification as necessary. This RFP does not commit TVA to make an award. TVA reserves the right to select the proposal(s) considered to be in the overall best interest of TVA. TVA reserves the right to reject any or all proposals if such action is in the best interest of TVA. Evaluation Factors- Generally
In comparing proposals and making awards, TVA may consider various factors in addition to cost, such as relative quality and adaptability of supplies or services, financial responsibility, safety history, skill, experience, past performance, record of integrity in dealing, technical capability, and time of delivery.

Evaluation Factors

Evaluation criteria to be considered by TVA in determining which proposal is most advantageous to TVA will include total cost of ownership to TVA. Evaluation criteria considered may also include:
Delivery terms
Ability to meet TVA technical requirements and specifications
Quality of products or services offered
Experience and past performance
Agreement to TVA's terms and conditions

Financial capability

As part of its evaluation, TVA may investigate the qualifications, references, and facilities of a Proposer, including an inspection of a Proposer's offices, distribution, and manufacturing facilities. By submitting a proposal, the Proposer hereby agrees to cooperate with TVA in conducting any such investigation. Further, Proposer agrees that TVA may perform survey or visit to the Proposer's facilities, and Pre-award cost audit.

Acceptable Proposals

Proposals must contain the information requested and shall be in sufficient form and detail to enable a comprehensive understanding and analysis. Prior to evaluation, the Contracting Officer may review proposals to determine compliance with preparation instructions, terms and conditions, and

other administrative conditions. Failure to comply the requirements of this solicitation may cause a proposal to be rejected without further consideration.
In addition to any other evaluation criteria, Proposers may be evaluated on their financial condition and strength to support TVA's requirements. This evaluation may be done on a pass/fail basis. Proposals which, in TVA's sole judgment, do not have the financial capabilities to support TVA's requirements will not be considered for award.

Evaluation Process

TVA will evaluate the proposals using numeric scoring and a total score will be computed for each proposal. Using these scores, TVA will establish a competitive range.
TVA may, in its discretion, request clarifications or conduct discussions with any or all Proposers, or only those Proposers in the competitive range.

12. TVA Contact Information

The designated RFP Contact Person is:

Veronica Wilson
Tennessee Valley Authority
Contract Manager
1101 Market Street, LP 4T
Chattanooga, TN 37402
vwilson@tva.gov Email
(423) 751-2111 Telephone

All correspondence must be sent through Veronica Wilson. Failure to follow communication guidelines may result in exclusion from consideration.

APPENDIX I

Consumption of Generated Output

Responses that include total consumption of all energy produced by the waste heat recovery system will be evaluated as having an advantage over responses that have excess generation not consumed on-site, but responses will not be disqualified if excess electricity is produced. The proposer will be required to comply with the requirements for exporting excess electricity to the grid and will be required to comply with the requirements of the Dispersed Power Production (DPP) Guidelines, including execution of a power purchase agreement with TVA. . Information on the DPP can be found at http://www.tva.gov/abouttva/pdf/dispersed.pdf. Further, the proposers will include any earned revenue from the DPP Contract within the Budget Information

Interconnection

While the preference is for all generation to be utilized on site, the proposer shall comply with TVA Small Generator Interconnection Procedures (SGIP), applicable standards, and local building codes. Current TVA SGIP guidelines for WHR systems connected directly to the TVA system are available at http://www.oatioasis.com/tva/tvadocs/TVASGIP.pdf. For a proposer connecting to a local power company's distribution system, proposer should consult with the local power company (distribution utility) regarding requirements for interconnection on that system. Proposers are responsible for all costs, whether through TVA or a local power company, for interconnection studies and electric system upgrades required to interconnect WHR systems to the electric system.

APPENDIX II – Intent to Bid

INTENT TO BID FORM

_____
(Company/Organization) intends to submit a response to the

Tennessee Valley Authority regarding RFP# _____ Waste Heat Recovery – November 2013.

_____
Corporation/Company Name

_____
Legal Signatory for Corporation/Company (print name)

_____
Signature

_____
Date

_____
Contact Telephone Number

_____
Contact Email Address

Remit by email to: vwilson@tva.gov

APPENDIX III – Frequently Asked Questions

Solicitation for Waste Heat Recovery Initiative Attachment III

Frequently Asked Questions
Environmental Mitigation Projects
October 2013

Clean/Renewable Energy Projects

Waste Heat Recovery

Q: **What is the Waste Heat Recovery (WHR) project and what are the objectives for the project?**
A: In April 2011, TVA entered into clean air agreements with the Environmental Protection Agency (EPA), four states and three environmental groups ("EPA Agreements"). These Agreements provide for the implementation of environmental mitigation projects that support cleaner air across the region. The Waste Heat Recovery is one of the selected projects.
Specific objectives include:
- Increasing TVA's industrial customers' access to clean energy from WHR.
- Providing highly leveraged funding opportunities for new clean energy in the Valley.
- Providing a model for future innovative and cost-effective clean energy technologies.

Q: **What is TVA's role in this project?**
A: TVA will provide general technical oversight and financial assistance with the project's capital funding by issuing progress-based payments during the design, construction and commissioning period. TVA will also conduct appropriate measurement and verification activities to determine the emissions reductions benefits of the WHR installation.

Q: **When will TVA issue the Request for Proposal (RFP) and who will receive it?**
A: TVA will send out the RFP in November 2013. And it will be sent to all TVA's industrial customers as well as the local power companies to help identify possible candidates in their service areas who would be able to participate. The RFP will also be posted on TVA's website at http://www.tva.com/environment/epa_mitigation/waste_heat_recovery.htm

Q: **How will TVA ensure a fair bidding process for the project(s)?**
A: First, all eligible parties will be given the same information to help them create their proposals. In evaluation of the proposals, TVA will use a common, numeric scoring system so that each project is evaluated on the same criteria and a total score will be computed for each proposal. Using these scores, TVA will establish a competitive range. TVA may, in its discretion, request clarifications or conduct discussions with any or all Proposers, or only those Proposers in the competitive range. Specific elements for evaluation are found within the RFP.

Q: **Will energy generated from the WHR project have to be consumed onsite?**
A: It is preferred but not required that the generated energy be consumed on site. Responses that include total consumption of all energy produced by the waste heat recovery system will be evaluated as having an advantage over responses that have excess generation not consumed on-site. If any energy is not consumed by the host, a separate Dispersed Power Production agreement between TVA and the host site would need to be developed.

Q: **Is this available to all industrial customers, whether distributor or direct-serve?**
A: Yes; all customers with greater than 5 MW demand

Q: Will the generated energy be purchased by TVA, and if so, at what rate?

A: Only if not consumed by the host and exported to a third party (see question above). The rate will be determined by Dispersed Power Production Agreement negotiations.

Q: Can customers participating in the Waste Heat Recovery Project also qualify for participation in the Energy Right Solutions for Industry >5MW (ERSI >5MW) and be offered assessments to identify potential savings?

A: Unlike the ERSI >5MW, customers participating in the EPA WHR Project will be responsible for arranging the initial assessment. Customers will have the option of participating in the ERSI >5MW program which could cover the initial engineering assessment for potential projects, but not in both programs.

Q: Are directly-served customers eligible to receive an assessment to identify opportunity for WHR projects, similar to other process assessments TVA provides?

A: No - Customers choosing to participate in the EPA WHR Project will not receive an initial engineering assessment. The customers will be required to submit a response to the RFP on how and where they would use waste heat to produce electricity, estimated amount of electricity produced, emissions reductions, project cost share and pertinent information regarding the project.

Q: Will the EPA WHR incentives be in addition to ERSI >5MW incentives? If yes, can they receive both or will it be limited to an overall cap of 70 percent?

A: No - The EPA WHR Project is a standalone project separate from the ERSI >5MW program; therefore, all project funding, resources, and benefits are accounted for under the EPA Mitigation WHR Project. If multiple projects are submitted and exhaust all funding for mitigation projects under the EPA Agreement, then the ERSI >5MW program may choose to select other waste heat projects as potential projects. Customers have the option of choosing between the EPA WHR Project or ERSI >5MW path. The cost sharing requirements of the submitted proposals will be an evaluation factor under the WHR Project. -

Q: The fact sheet states TVA is looking for 5 MW and is budgeting $7 million over five years. Does that mean an incentive of 7 / 5 = $1.4 million per MW incentive?

A: Potentially - the $7 Million committed to the WHR project is to cover all aspects or portions of the project requirements such as , engineering design, equipment purchase, installation, and commissioning. The 5MW is identified as the minimum target goal for the WHR Project; if the project or projects selected exceed the 5 MW goal then the funds will be used in the most cost-effective approach to reach the goal.

Q: How many customers or how many projects will receive an EPA WHR incentive award?

A: It is yet to be determined - the selection of the project or projects will be determined during the proposal review process; the WHR Project is not set by the number of customers or projects. The project could be a single 5 MW project and consume the full amount of $7 Million or it could be multiple projects of varying size with the share of $7 Million as necessary by the project host to develop and complete the project.

Q: Is it okay for a project to reach completion prior to the five-year deadline?

A: Yes - the 2017 date is the latest the project must be completed and in operation – earlier completion is acceptable and encouraged. Projects will have an Estimated Useful Life of at least twelve years. Measurement, evaluation and reporting may go beyond the January 2017 date.

Q: Will Industrial customers selected be required to enter into any contracts or agreements?

A: Yes, a contract will be required between the customer and TVA before any funds can be allocated. Also, if not all the electricity is consumed onsite and excess electricity is sold back to TVA or the Local Power Company, the industrial customer must agree to a Dispersed Power Production Agreement and an Interconnection Agreement. Potential also exists for a Standby Rate contract depending upon the size of the project and the impact on TVA and/or the Local Power Company. Information on the agreements will be included within the RFP.

Q: **How will TVA evaluate the Request for Proposal responses?**

A: TVA will evaluate the proposals using numeric scoring and a total score will be computed for each proposal. Using these scores, TVA will establish a competitive range. TVA may, at its discretion, request clarifications or conduct discussions with any or all Proposers, or only those Proposers in the competitive range. Specific elements for evaluation are found within the RFP.

Q: **How can I learn more information about the WHR project?**

A: TVA has information about the WHR project on its website at http://www.tva.com/environment/epa_mitigation/waste_heat_recovery.htm. In addition, those who are interested my e-mail wasteheatrecovery@tva.com with questions.